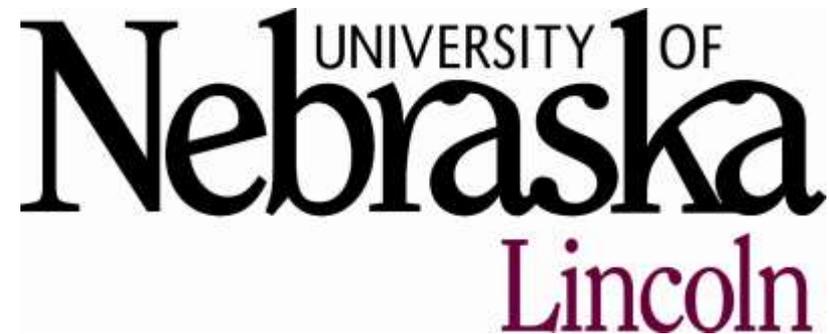


Nutrient management as impacted by diet & mgmt

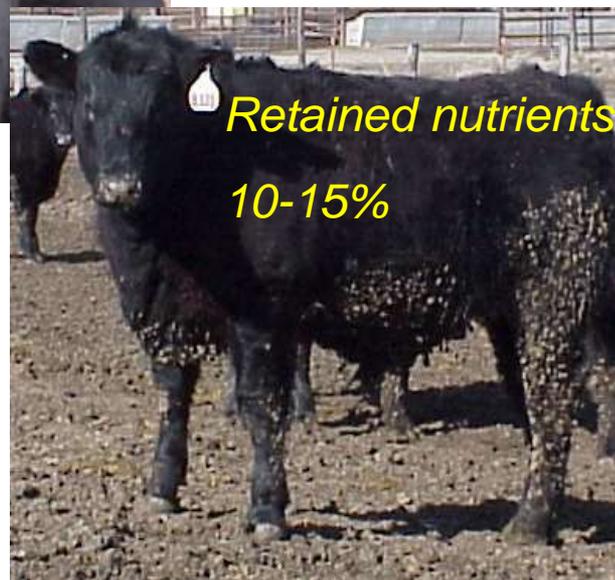


G. Erickson, T. Klopfenstein,
R. Koelsch, & many students





Intake



Excretion

Intake-Retention=Excretion

Excretion in feces & urine



Methods

nutrient balance experiments



- Soil core samples (15 cm)
- Runoff events quantified and sampled
- Manure removed
Weighed, sampled, analyzed
- Soil core samples
- N retention calculated using NRC equations

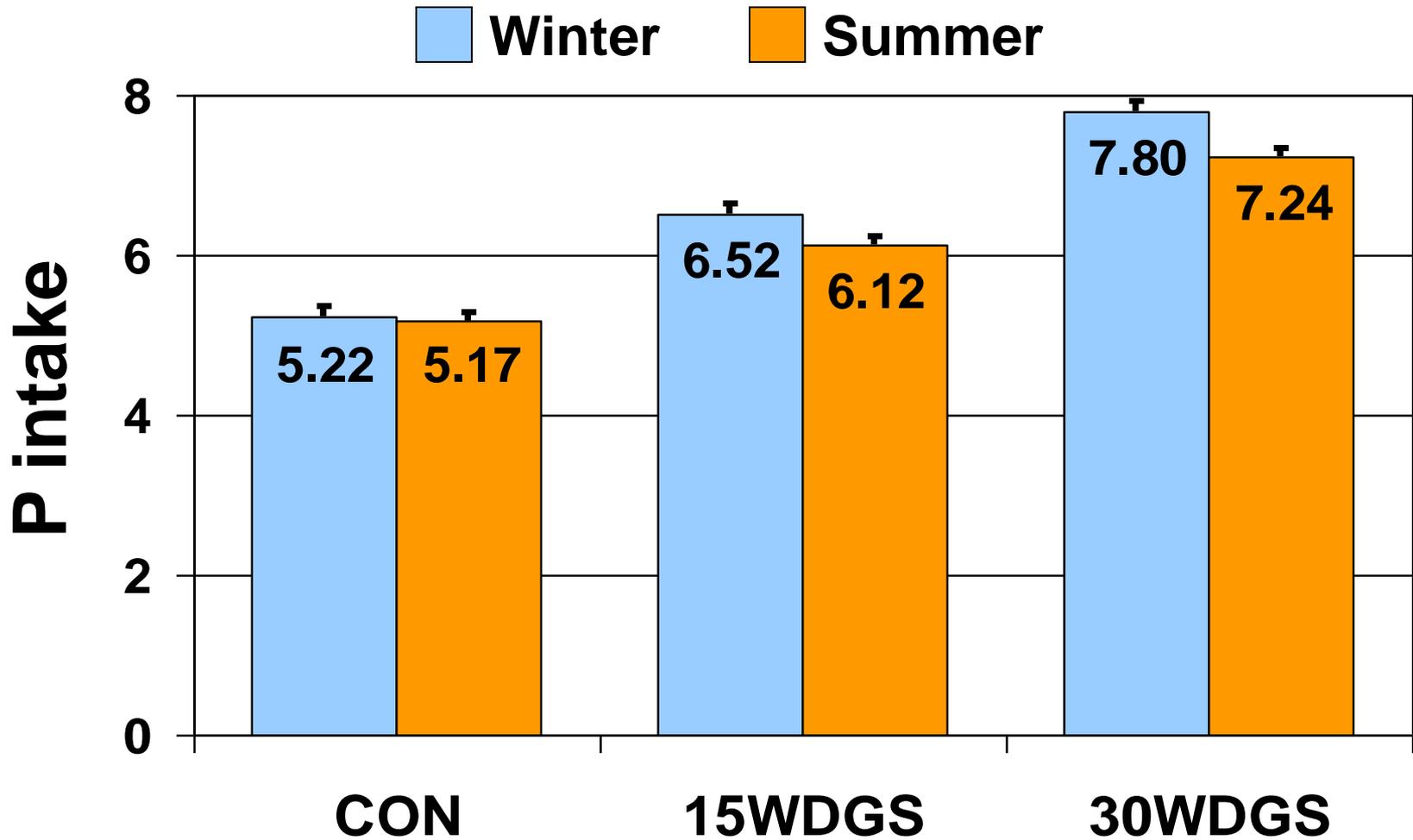
Methods

Nutrient balance experiments

- intake - retention = excretion
- manure, soil balance, runoff
- N losses calculated as difference:
 - $N \text{ lost} = N \text{ excretion} - N \text{ manure} - N \text{ soil} - N \text{ runoff}$



Mass Balance, $\text{kg}\cdot\text{steer}^{-1}$



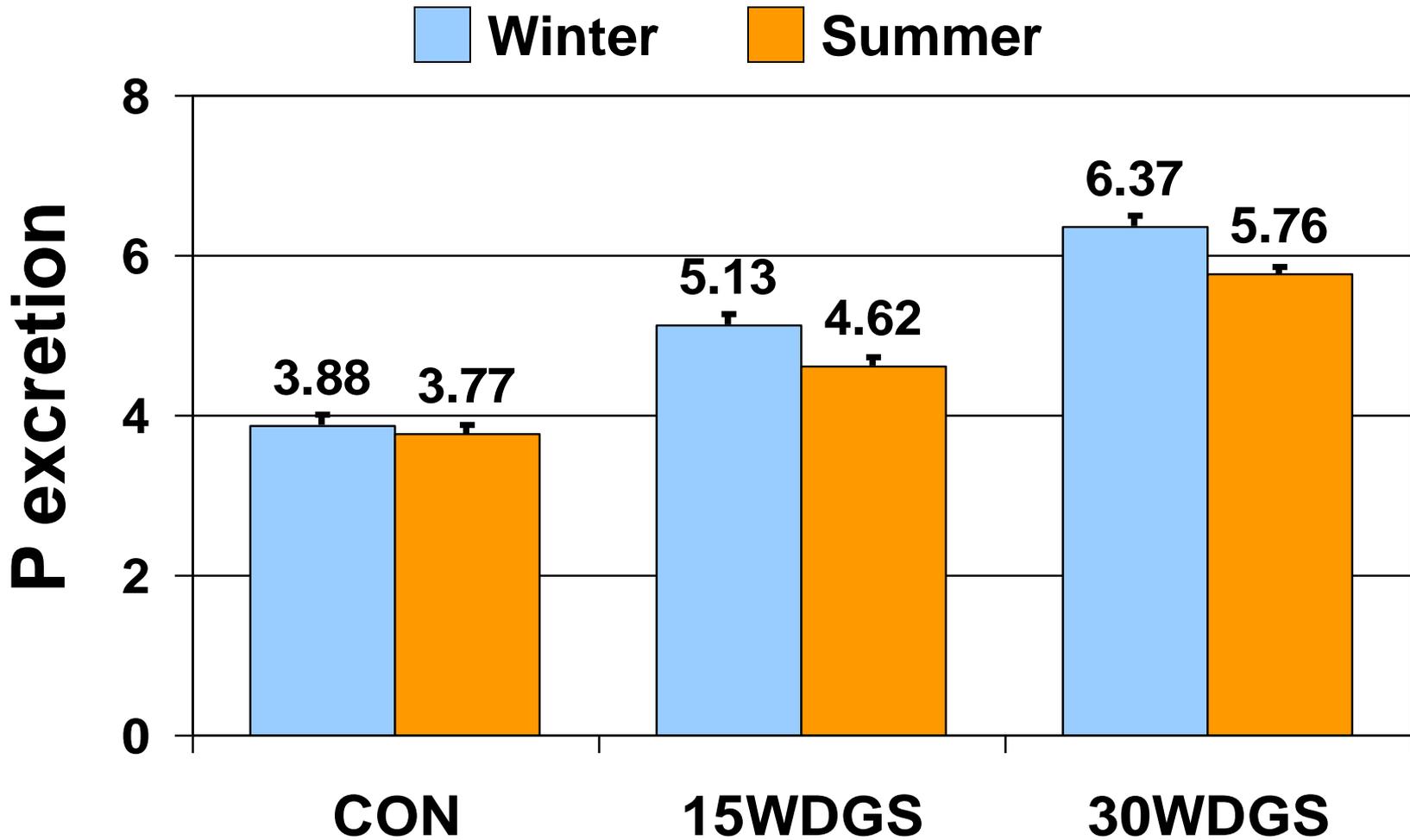
WINTER

Linear $P < 0.01$

SUMMER

Linear $P < 0.01$

Mass Balance, $\text{kg}\cdot\text{steer}^{-1}$



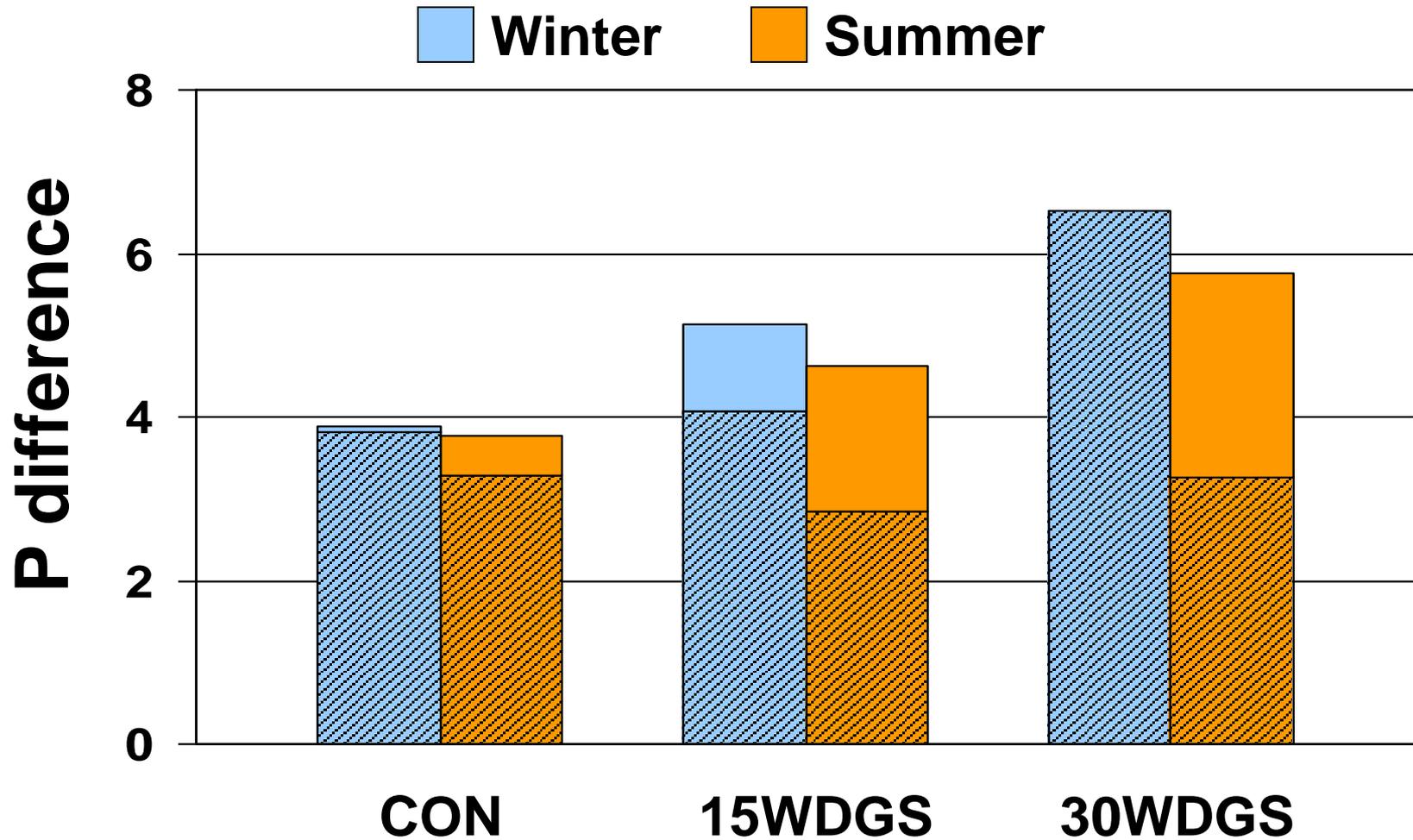
WINTER

Linear $P < 0.01$

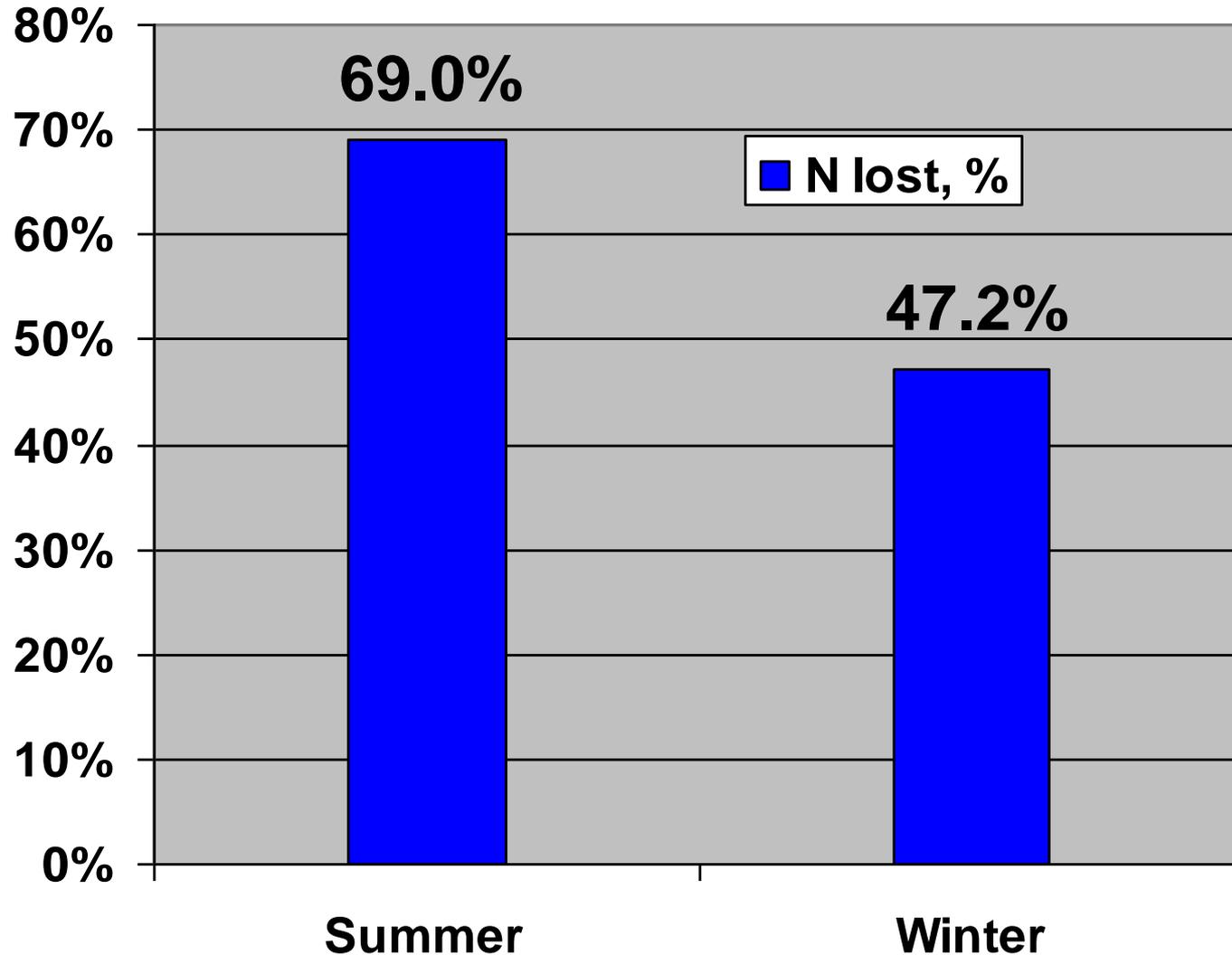
SUMMER

Linear $P < 0.01$

Excretion and Soil Correction



Seasonal Feeding Period Comparison of Percent N Lost



Reducing N losses

- Reduce amount of N intake
- Improve C:N ratio in manure
 - Decrease diet digestibility
 - Promote hindgut fermentation
 - Amendment
- Decrease pH of pen surface
- Remove manure more frequently
- Storage and handling

Feeding distillers

Summer, kg•steer⁻¹

WDGS Level

	0	15	30	SEM	P-value
N intake ¹	28.9 ^a	35.5 ^b	42.9 ^c	0.5	< 0.01
N retention	4.6	4.9	4.9	0.1	0.16
N excretion ¹	24.3 ^a	30.5 ^b	38.0 ^c	0.5	< 0.01

¹ Linear effect WDGS Level ($P < 0.05$)

^{a,b,c} Means within a row with unlike superscripts differ ($P < 0.05$)

Feeding distillers

Summer, kg•steer⁻¹

WDGS Level

	0	15	30	SEM	P-value
Manure N ¹	9.0	9.7	10.0	2.3	0.89
Runoff N	1.25	0.87	1.53	0.54	0.53
N lost ¹	14.1 ^a	20.0 ^b	26.5 ^c	2.3	<0.01
N loss, %	58.1	65.6	69.6	7.2	0.32

¹ Linear effect WDGS Level ($P < 0.05$)

^{a,b,c} Means within a row with unlike superscripts differ ($P < 0.05$)

Luebke, M. K., G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist. 2008.
 Nutrient mass balance and performance of feedlot cattle fed wet distillers grains.
 Nebraska Beef Rep. MP91:53-56.

Feeding distillers

Winter, kg•steer⁻¹

WDGS Level

	0	15	30	SEM	P-value
N intake ¹	31.5 ^a	36.2 ^b	44.6 ^c	0.7	< 0.01
N retention ¹	5.8	6.1	6.3	0.2	0.08
N excretion ^{1,2}	25.6 ^a	30.1 ^b	38.4 ^c	0.7	< 0.01

¹ Linear Effect WDGS Level ($P < 0.05$)

² Quadratic Effect ($P < 0.05$)

^{a,b,c} Means within a row with unlike superscripts differ ($P < 0.05$)

Feeding distillers

Winter, kg•steer⁻¹

WDGS Level

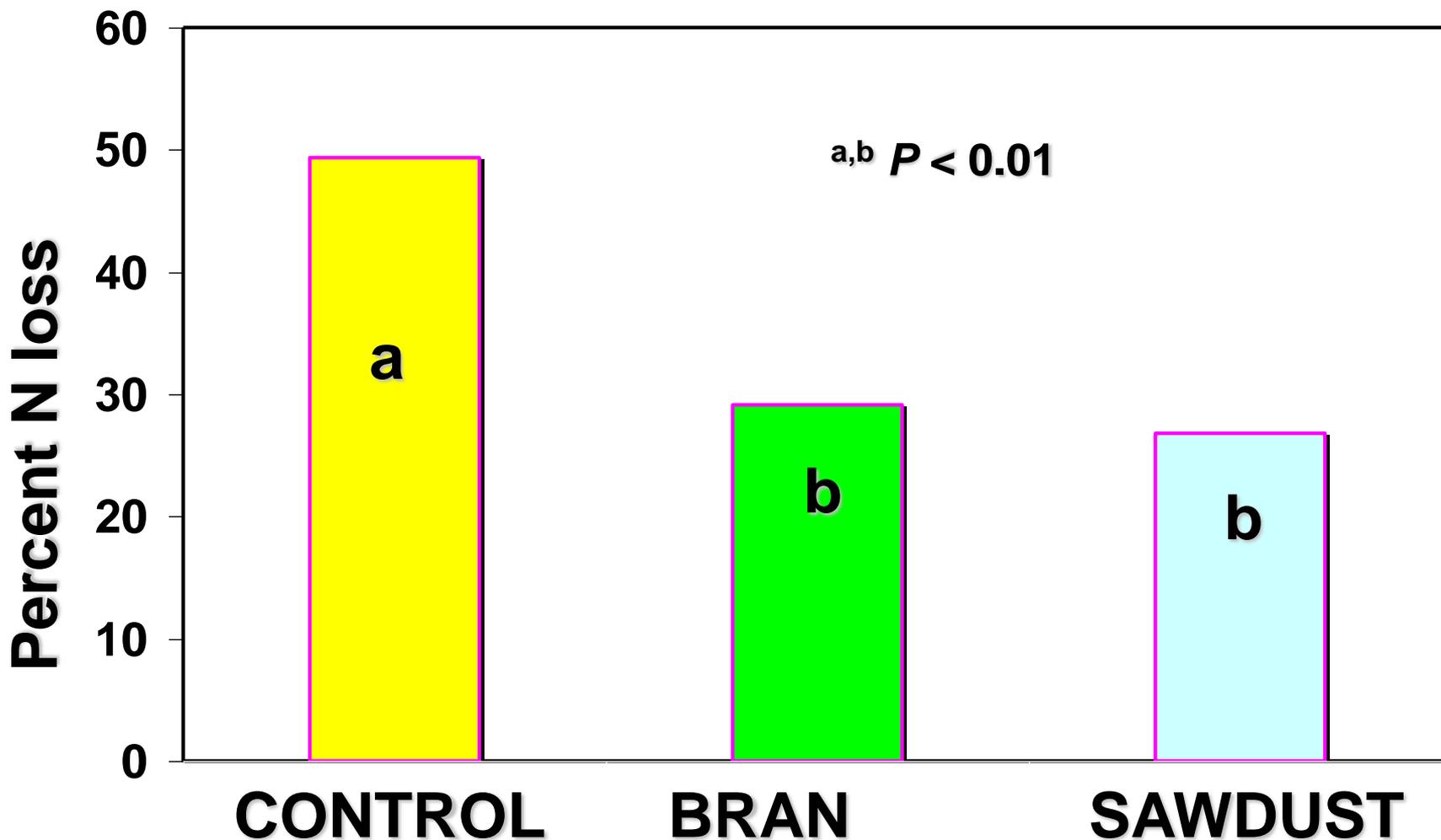
	0	15	30	SEM	P-value
Manure N [*]	8.4	10.3	11.2	1.4	0.16
N lost ¹	14.1 ^a	19.2 ^b	21.1 ^b	2.1	0.03
N loss, %	55.1	63.8	55.0	6.8	0.37

*Linear Effect WDGS Level ($P = 0.07$)

¹ Linear Effect WDGS Level ($P < 0.05$)

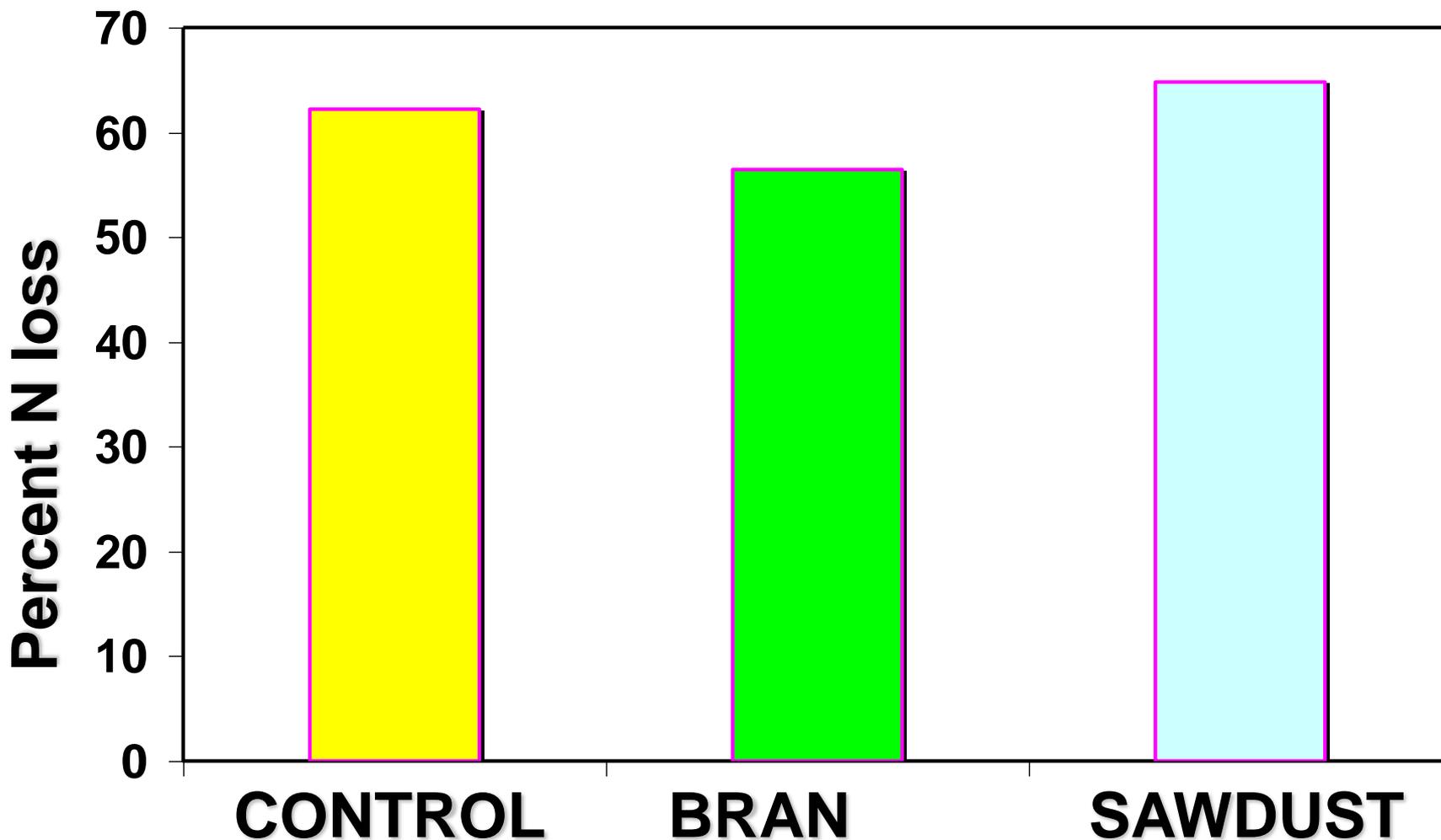
^{a,b,c} Means within a row with unlike superscripts differ ($P < 0.05$)

Adding carbon, winter/spring



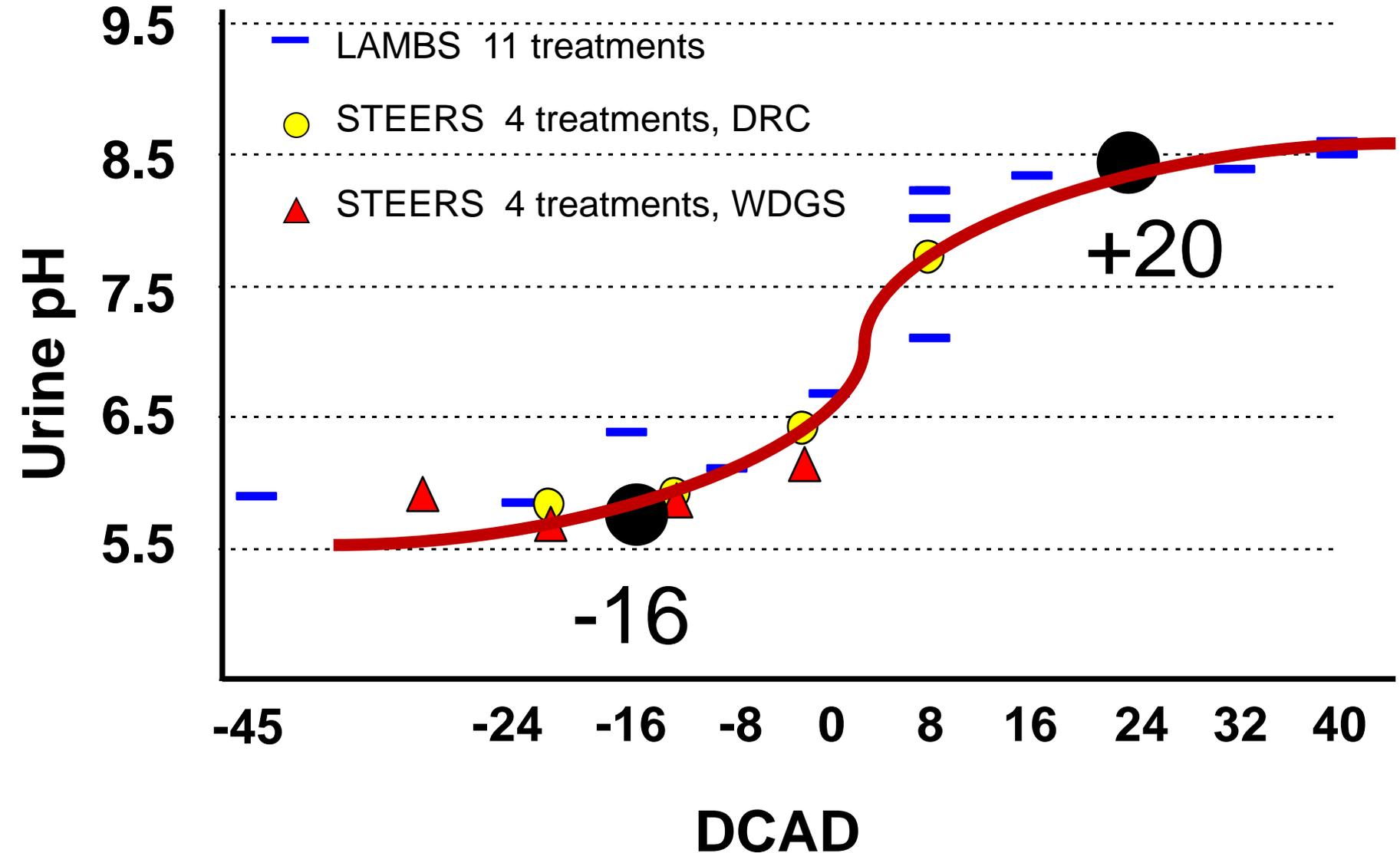
Adams, J. R., T. B. Farran, G. E. Erickson, T. J. Klopfenstein, C. N. Macken, and C. B. Wilson. 2004. Effect of organic matter addition to the pen surface and pen cleaning frequency on nitrogen balance in open feedlots. *J. Anim. Sci.* 82:2153-2163.

Adding carbon, summer



Adams, J. R., T. B. Farran, G. E. Erickson, T. J. Klopfenstein, C. N. Macken, and C. B. Wilson. 2004. Effect of organic matter addition to the pen surface and pen cleaning frequency on nitrogen balance in open feedlots. *J. Anim. Sci.* 82:2153-2163.

DCAD



DCAD

	NEG¹	POS¹	SEM	P-value
Manure pH	8.40	8.80	0.06	<0.01
Manure N	18.8	17.7	2.9	0.73
N lost	12.9	14.0	2.0	0.59
N loss, %	39.1	40.8	5.9	0.78

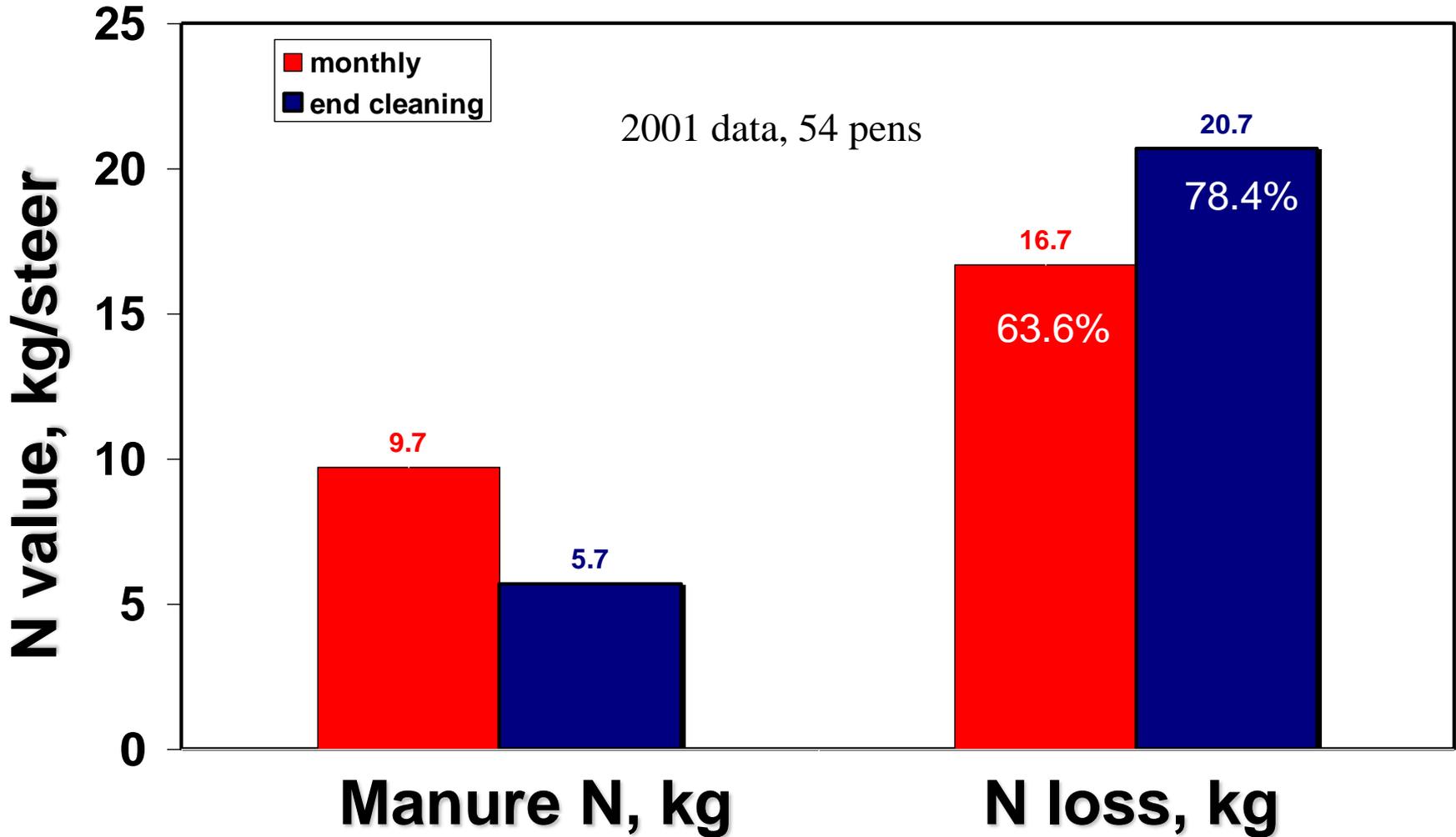
¹ NEG = -16, POS = +20

DCAD

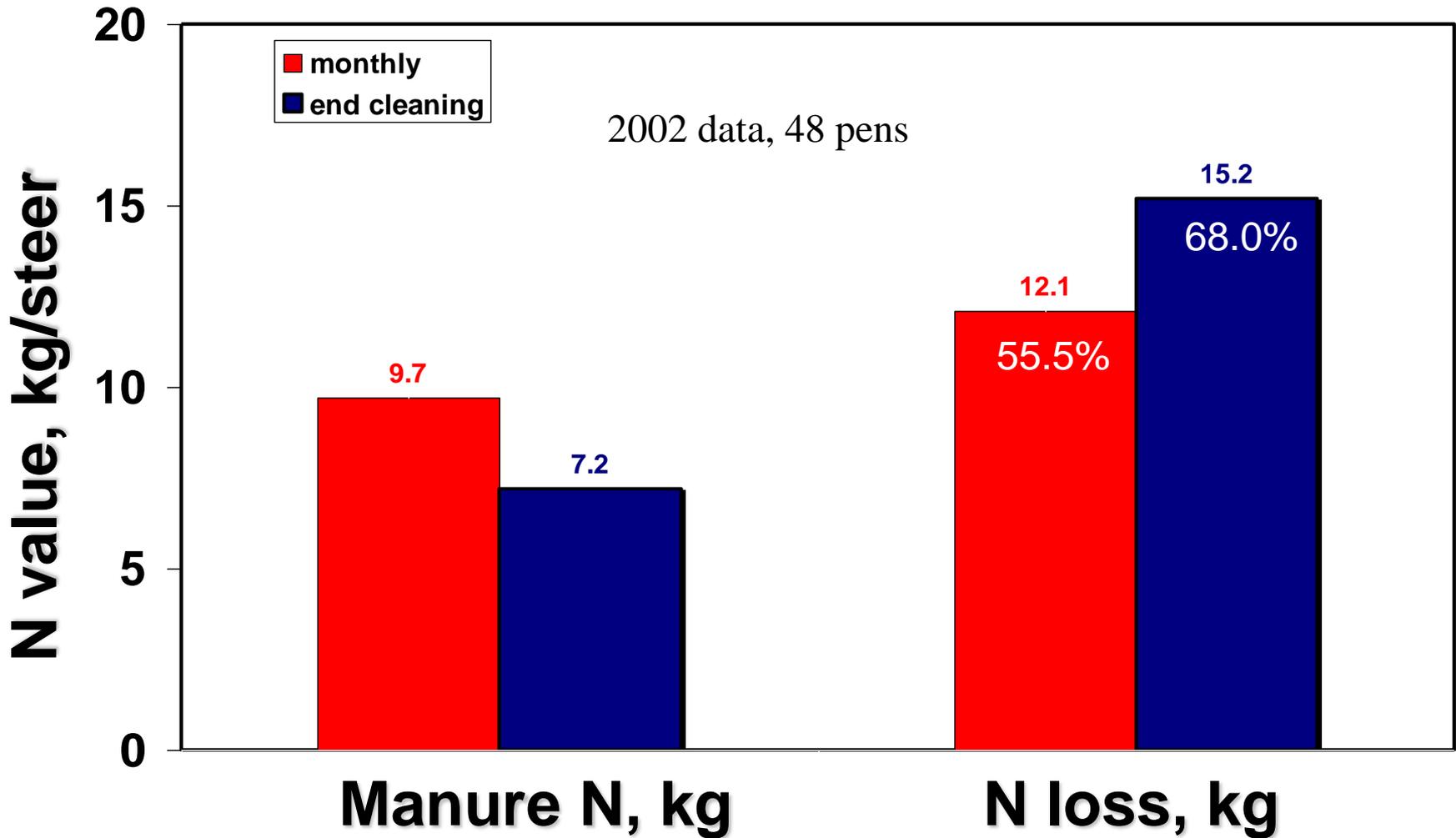
	NEG¹	POS¹	SEM	P-value
Manure pH	7.70	8.12	0.07	<0.01
Manure N	11.7	11.1	1.5	0.67
N lost	19.5	21.4	1.0	0.07
N loss, %	61.3	64.6	3.7	0.39

¹ NEG = -16, POS = +20

Cleaning Frequency



Cleaning Frequency



- Fresh



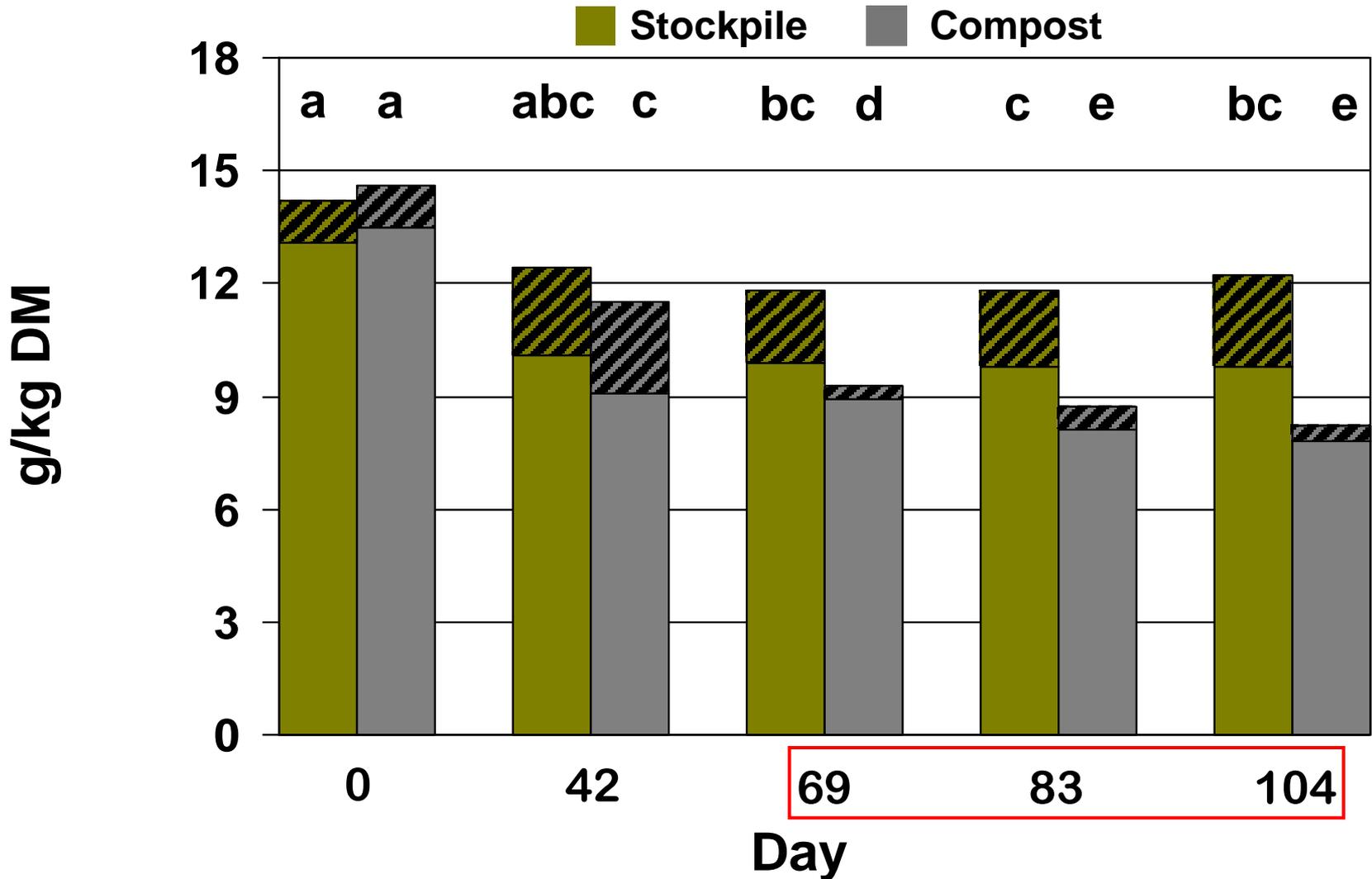
- Stockpiling



- Composting



Manure Handling



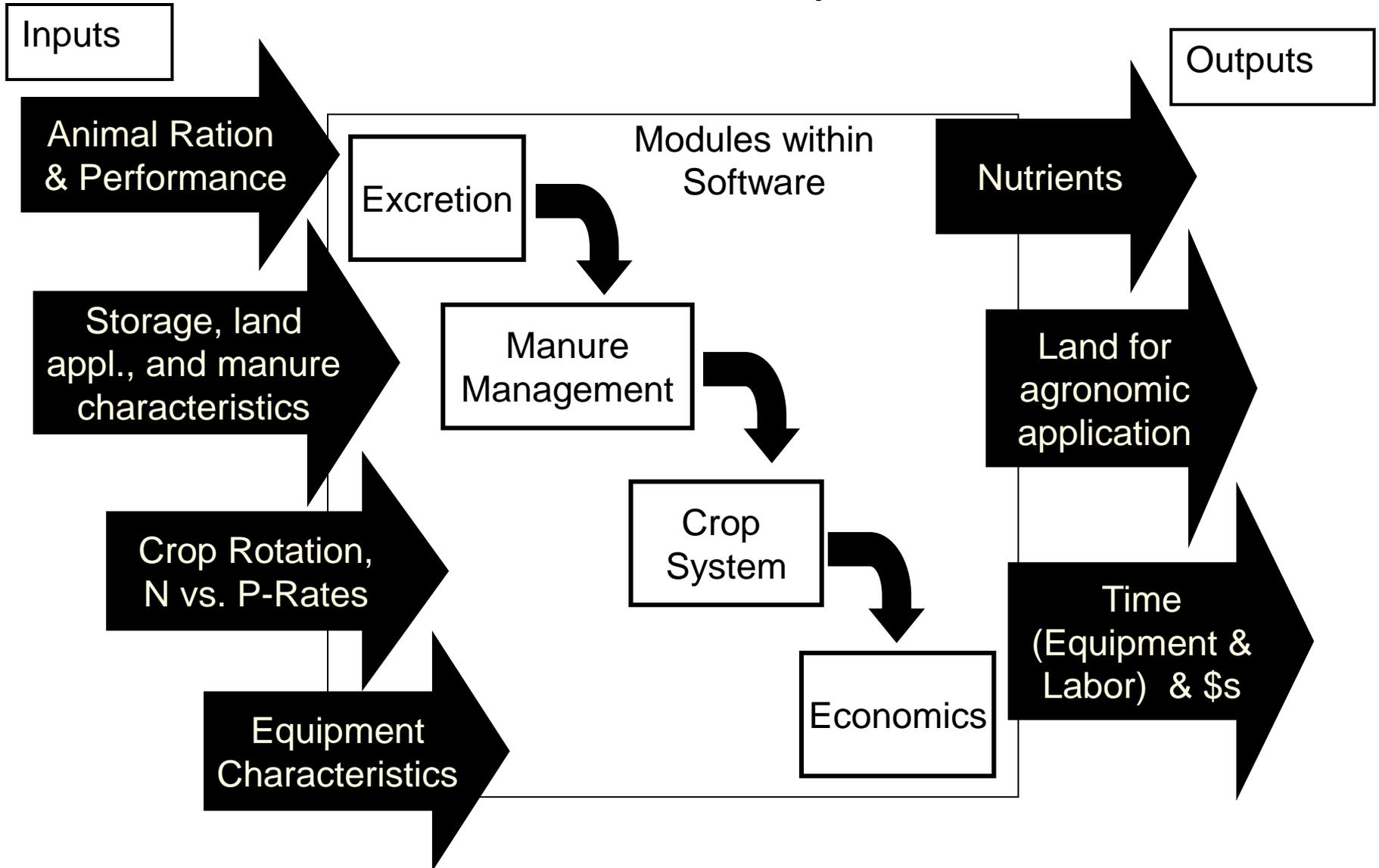
Storage*Day $P < 0.01$

a,b,c,d,e $P < 0.05$

Storage $P < 0.01$

Luebbe et. al., 2008. Aerobic composting or anaerobic stockpiling of feedlot manure. Neb. Beef Rep. MP91:56-58.
Luebbe et. al., 2009. Composting or stockpiling feedlot manure: Nutrient concentration and recovery. MP92:96-98.

FNMP\$



Geisert, B. G., **G. E. Erickson**, T. J. Klopfenstein, C. N. Macken, M.K. Luebbe, and J.C. MacDonald. 2010. Phosphorus requirement and excretion of phosphorus for finishing beef cattle. *J. Anim. Sci.* (accepted).

Luebbe, M. K., **G. E. Erickson**, T. J. Klopfenstein, and M. A. Greenquist. 2010. Nutrient mass balance and performance of feedlot cattle fed corn wet distillers grains plus solubles. *J. Anim. Sci.* (accepted).

Luebbe, M. K., **G. E. Erickson**, T. J. Klopfenstein, M. A. Greenquist, and J. R. Benton. 2010. Effect of dietary cation-anion difference on urinary pH, feedlot performance, nitrogen mass balance and manure pH in open feedlot pens. *J. Anim. Sci.* (accepted).

Erickson, G. E., and T. J. Klopfenstein. 2010. Nutritional and management methods to decrease nitrogen losses from beef feedlots. *J. Anim. Sci.* 88:E172-E180.

Bremer, V. R., A. J. Liska, T. J. Klopfenstein, **G. E. Erickson**, H. S. Yang, D. T. Walters, and K. G. Cassman. 2010. Emissions savings in the corn-ethanol life cycle from feeding co-products to livestock. *J. Environ. Qual.* 39:472-482.

Liska, A. J., H. S. Yang, V. R. Bremer, T. J. Klopfenstein, D. T. Walters, **G. E. Erickson**, and K. G. Cassman. 2009. Improvements in life cycle energy efficiency and greenhouse gas emissions of corn-ethanol. *J. Industrial Ecology* 13:58-74.

Farran, T. B., **G. E. Erickson**, T. J. Klopfenstein, C. N. Macken, and R. U. Lindquist. 2006. Wet corn gluten feed and alfalfa hay levels in dry-rolled corn finishing diets: Effects on finishing performance and feedlot nitrogen balance. *J. Anim. Sci.* 84:1205-1214.

Adams, J. R., T. B. Farran, **G. E. Erickson**, T. J. Klopfenstein, C. N. Macken, and C. B. Wilson. 2004. Effect of organic matter addition to the pen surface and pen cleaning frequency on nitrogen balance in open feedlots. *J. Anim. Sci.* 82:2153-2163.

Block, H. C., **G. E. Erickson**, T. J. Klopfenstein. 2004. Review: Re-evaluation of phosphorus requirements and phosphorus retention of feedlot cattle. *Prof. Anim. Scientist.* 20:319-329.

Erickson, G. E., T. J. Klopfenstein, C. T. Milton, D. Brink, M. W. Orth, and K. M. Whittet. 2002. Phosphorus requirement of finishing feedlot calves. *J. Anim. Sci.* 80:1690-1695.

Erickson, G. E., and T. J. Klopfenstein. 2001. Managing N inputs and the effect on N volatilization following excretion in open-dirt feedlots in Nebraska. *Nitrogen in the Environment, TheScientificWorld*, URL: <http://www.thescientificworld.com> 1(S1): 830-835.

Erickson, G. E., and T. J. Klopfenstein. 2001. Nutritional methods to decrease N volatilization from open-dirt feedlots in Nebraska. *Nitrogen in the Environment, TheScientificWorld*, URL: <http://www.thescientificworld.com> 1(S1): 836-843.

Erickson, G. E., T. J. Klopfenstein, C. T. Milton, D. Hanson, and C. Calkins. 1999. Effect of dietary phosphorus on finishing steer performance, bone status, and carcass maturity. *J. Anim. Sci.* 77:2832-2836.

Bierman, S., **G. E. Erickson**, T. J. Klopfenstein, R. A. Stock, and D. H. Shain. 1999. Evaluation of nitrogen and organic matter balance in the feedlot as affected by level and source of dietary fiber. *J. Anim. Sci.* 77:1645-1653.

2 year (4 turns) summary

Protein level

Overfeeding protein increases N losses

Nutrition may:

decrease N inputs by 10 to 20%

reduces N excretion by 12 to 21%

reduces N volatilization by 15 to 33%

Based on annual occupancy, lose 50% of N excreted

- 53.5% annually for Control, or 103 g/hd/d
- 48.2% annually for Phase, or 78 g/hd/d

Conclusions

Losses are ~50% of excreted N
Greater in summer, less in the winter
Equates to ~0.25 lb per head per day

What we have evaluated:

- Diet Protein
- Increase organic matter
- Clean more frequently
- Acidify manure
- Distillers grains
- Manure storage